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(54)【発明の名称】 耐チップング性にすぐれた表面被覆炭化タングステン基超硬合金製切削工具

(57)【要約】

【目的】 表面被覆WC基超硬合金製切削工具の耐チップング性を向上させる。

【構成】 WC基超硬合金基体の表面に、TiC、TiN、TiCN、TiCO、およびTiCNOのTi化合物のうちの1層の単層または2種以上の複層からなる下部層と、前記Ti化合物並びにAl₂O₃のうちの1種の単層または2種以上の複層からなる上部層で構成された硬質被覆層を形成するに際して、上記上部層のうちの少なくとも1層をTiCNで構成すると共に、このTiCN層のうちの少なくとも1層を、(a)粒状結晶組織から縦長成長結晶組織へ変る結晶構造、(b)粒状結晶組織から縦長成長結晶組織へ、さらにこの縦長成長結晶組織から粒状結晶組織へ変る結晶構造、(c)縦長成長結晶組織から粒状結晶組織へ変る結晶構造のうちのいずれの結晶構造とする。

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【特許請求の範囲】

【請求項1】 炭化タングステン基超硬合金基体の表面に、いずれも粒状結晶組織を有する硬質被覆層を0.5～20 μ mの平均層厚で形成してなる表面被覆炭化タングステン基超硬合金製切削工具において、上記硬質被覆層を、Tiの炭化物、窒化物、炭窒化物、炭酸化物、および炭窒酸化物のTi化合物のうちの1種の単層または2種以上の複層からなる下部層と、前記Ti化合物並びに酸化アルミニウムのうちの1種の単層または2種以上の複層からなる上部層で構成し、かつ上記上部層のうちの少なくとも1層を炭窒化チタンで構成すると共に、この炭窒化チタン層のうちの少なくとも1層の結晶構造を、

(a) 粒状結晶組織から縦長成長結晶組織へ変る結晶構造、

(b) 粒状結晶組織から縦長成長結晶組織へ、さらにこの縦長成長結晶組織から粒状結晶組織へ変る結晶構造、

(c) 縦長成長結晶組織から粒状結晶組織へ変る結晶構造、上記(a)～(c)のうちのいずれかの結晶構造としたことを特徴とする耐チップング性にすぐれた表面被覆炭化タングステン基超硬合金製切削工具。

【請求項2】 結合相形成成分としてのC_oの含有量が基体内部に比して相対的に多い表面部を有する炭化タングステン基超硬合金基体の表面に、いずれも粒状結晶組織を有する硬質被覆層を0.5～20 μ mの平均層厚で形成してなる表面被覆炭化タングステン基超硬合金製切削工具において、

上記硬質被覆層を、Tiの炭化物、窒化物、炭窒化物、炭酸化物、および炭窒酸化物のTi化合物のうちの1種の単層または2種以上の複層からなる下部層と、前記Ti化合物並びに酸化アルミニウムのうちの1種の単層または2種以上の複層からなる上部層で構成し、かつ上記上部層のうちの少なくとも1層を炭窒化チタンで構成すると共に、この炭窒化チタン層のうちの少なくとも1層の結晶構造を、

(a) 粒状結晶組織から縦長成長結晶組織へ変る結晶構造、

(b) 粒状結晶組織から縦長成長結晶組織へ、さらにこの縦長成長結晶組織から粒状結晶組織へ変る結晶構造、

(c) 縦長成長結晶組織から粒状結晶組織へ変る結晶構造、上記(a)～(c)のうちのいずれかの結晶構造としたことを特徴とする耐チップング性にすぐれた表面被覆炭化タングステン基超硬合金製切削工具。

【発明の詳細な説明】

【0001】

【産業上の利用分野】 この発明は、すぐれた耐チップング性を有し、したがって例えば鋼や鋳鉄などの連続切削は勿論のこと、これらの断続切削に用いた場合にもすぐ

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れた耐摩耗性を発揮する表面被覆炭化タングステン(以下、WCで示す)基超硬合金製切削工具に関するものである。

【0002】

【従来の技術】 従来、一般に、例えば特開昭57-1585号公報および特開昭59-52703号公報に記載されるように、WC基超硬合金基体や、さらに結合相形成成分としてのC_oの含有量が基体内部に比して相対的に多い表面部、すなわちC_o富化表面部を有するWC基超硬合金基体の表面に、化学蒸着法や物理蒸着法を用いて、いずれも粒状結晶組織を有するTiの炭化物、窒化物、炭窒化物、炭酸化物、および炭窒酸化物、並びに酸化アルミニウム(以下、それぞれTiC, TiN, TiCN, TiCO, TiCNO、およびAl₂O₃で示す)のうちの1種の単層または2種以上の複層からなる硬質被覆層を0.5～20 μ mの平均層厚で形成してなる表面被覆WC基超硬合金製切削工具が、例えば鋼や鋳鉄の連続切削に用いられていることは良く知られるところである。

【0003】 また、上記のC_o富化表面部を有するWC基超硬合金基体が、例えば原料粉末としてTiNなどの窒化物粉末や、TaCNおよび(Ti, W)CNなどの炭窒化物粉末を配合し、これの圧粉体を通常の条件で真空焼結する方法などによって製造されることも知られている。

【0004】

【発明が解決しようとする課題】 一方、近年の切削加工技術のFA化および多様化は著しく、これに伴ない切削工具にも、例えば連続切削および断続切削のいずれでもすぐれた耐摩耗性を発揮する特性が要求されるが、上記の従来表面被覆WC基超硬合金製切削工具は、これを断続切削に用いた場合には、切刃にチップングが発生し易く、比較的短時間で使用寿命に至るのが現状である。

【0005】

【課題を解決するための手段】 そこで、本発明者等は、上述のような観点から、上記の従来表面被覆WC基超硬合金製切削工具に着目し、これの耐チップング性の向上をはかるべく研究を行なった結果、一般に、例えば化学蒸着法により硬質被覆層としてのTiCN層を形成するに際しては、

反応ガス組成：容量%で、TiCl₄：1～5%、CH₄：5～7%、N₂：20～30%、H₂：残り、
反応温度：950～1050℃、
雰囲気圧力：50～200トル、

の条件で形成され、形成されたTiCN層は粒状結晶組織を有するのが通常であるが、この粒状結晶組織を有するTiCN層形成の後半過程または中間過程、あるいは前半過程のTiCN層形成条件を、相対的に反応温度を低温にして、反応ガス組成をかえた条件、すなわち、

反応ガス組成：容量%で、TiCl₄：1～4%、CH

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α CN: 0.1~1%, N₂: 0~25%, H₂: 残り、

反応温度: 800~900℃、
雰囲気圧力: 30~200トル、

の条件にすると、この結果のTiCN層は、それぞれ、

(a) 粒状結晶組織から縦長成長結晶組織へ変る結晶構造、(b) 粒状結晶組織から縦長成長結晶組織へ、さらにこの縦長成長結晶組織から粒状結晶組織へ変る結晶構造、(c) 縦長成長結晶組織から粒状結晶組織へ変る結晶構造、上記(a)~(c)のうちのいずれかの結晶構造をもつようになり、しかも上記表面被覆WC基超硬合金製切削工具を構成するいずれも粒状結晶構成をもった硬質被覆層のうちの少なくとも1層を上記(a)~(c)のうちのいずれかの結晶構造をもったTiCN層で構成すると、この結果の表面被覆WC基超硬合金製切削工具は、すぐれた耐チップング性を具備するようになり、例えば鋼や鋳鉄の連続切削は勿論のこと、耐チップング性が要求されるこれらの断続切削でもすぐれた耐摩耗性を著しく長期に亘って発揮するという研究結果を得たのである。

【0006】この発明は、上記の研究結果にもとづいてなされたものであって、WC基超硬合金基体、またはC_o富化表面部を有するWC基超硬合金基体の表面に、いずれも粒状結晶組織を有する硬質被覆層を0.5~20μmの平均層厚で形成してなる表面被覆WC基超硬合金製切削工具において、上記硬質被覆層を、TiC, TiN, TiCN, TiCO, およびTiCNOのTi化合物のうちの1種の単層または2種以上の複層からなる下部層と、前記Ti化合物並びにAl₂O₃のうちの1種の単層または2種以上の複層からなる上部層で構成し、かつ上記上部層のうちの少なくとも1層をTiCNで構成すると共に、このTiCN層のうちの少なくとも1層の結晶構造を、(a) 粒状結晶組織から縦長成長結晶組織へ変る結晶構造、(b) 粒状結晶組織から縦長成長結晶組織へ、さらにこの縦長成長結晶組織から粒状結晶組織へ変る結晶構造、(c) 縦長成長結晶組織から粒状結晶組織へ変る結晶構造、上記(a)~(c)のうちのいずれかの結晶構造としてなる耐チップング性にすぐれた表面被覆WC基超硬合金製切削工具に特徴を有するものである。

【0007】なお、この発明の表面被覆WC基超硬合金製切削工具において、硬質被覆層の平均層厚を0.5~20μmとしたのは、その層厚が0.5μm未満では、硬質被覆層によってもたらされる所望のすぐれた耐摩耗性を確保することができず、一方その層厚が20μmを越えると切刃に欠けが発生し易くなるという理由によるものである。

【0008】

【実施例】つぎに、この発明の表面被覆WC基超硬合金製切削工具を実施例により具体的に説明する。原料粉末

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として、平均粒径: 3μmを有するWC粉末、同1.5μmの(Ti, W)C粉末(TiC/WC=重量比で30/70)、同1.2μmの(Ti, W)CN粉末(TiC/TiN/WC=重量比で24/20/56)、同1.3μmの(Ta, Nb)C粉末(TaC/NbC=重量比90/10)、および同1.2μmのC_o粉末を用意し、これら原料粉末を表1に示される配合組成に配合し、ボールミルで72時間湿式混合し、乾燥した後、圧粉体にプレス成形し、ついでこの圧粉体を、1×10⁻³トルの真空中、温度: 1450℃に1時間保持の条件で真空焼結することによりISO-CNMG120408の形状をもったWC基超硬合金基体A~C、およびC_o富化表面部(最大C_o含有量: 11重量%、厚さ: 20μm)を有するWC基超硬合金基体Dをそれぞれ製造した。また、上記WC基超硬合金基体Cについては、これに100トルのメタンガス雰囲気中、温度: 1400℃に1時間保持の条件で浸炭処理を施すことによりC_o富化表面部(最大C_o含有量: 17重量%、厚さ: 40μm)を形成した。

20 【0009】ついで、これらのWC基超硬合金基体A~Dの表面に、通常の化学蒸着装置を用い、表2に示される条件で表3に示される組成および平均層厚の単層または2層以上からなるいずれも粒状結晶組織を有する下部層を形成し、引続いて、同じく表2に示される条件で、表3に示される組成および平均層厚の単層または2層以上からなる上部層を形成するに際して、この上部層のうちの少なくとも1層をTiCN層とし、かつこのTiCN層のうちの少なくとも1層を、

30 反応ガス組成: 容量%で、TiCl₄: 3%, CH₄: 5%, N₂: 25%, H₂: 残り、

反応温度: 950℃、

雰囲気圧力: 100トル、

の粒状結晶組織形成条件と、

反応ガス組成: 容量%で、TiCl₄: 1.5%, CH₄: 0.5%, N₂: 25%, H₂: 残り、

反応温度: 860℃、

雰囲気圧力: 50トル、

の縦長成長結晶組織形成条件とを適宜組合せて表3に示される結晶構造とすることにより本発明表面被覆WC基超硬合金製切削工具(以下、本発明被覆切削工具という)1~8をそれぞれ製造した。

【0010】さらに、同じく表2に示される通常の条件で上記WC基超硬合金基体A~Dの表面に表4に示される組成および平均層厚を有し、かついずれも粒状結晶組織の硬質被覆層を形成することにより従来表面被覆WC基超硬合金製切削工具(以下、従来被覆切削工具という)1~8をそれぞれ製造した。

【0011】

【表1】

種 別	配 合 組 成 (重量%)				
	C o	(T i, W) C	(T a, N b) C	(T i, W) C N	W C
A	6	-	-	-	残
B	8	5	5	-	残
C	5	5	6	-	残
D	7	-	4	6	残

【0012】

【表2】

硬質被覆 層組成	粒状結晶組織の硬質被覆層形成条件		
	反応ガス組成 (容量%)	反応雰囲気 圧力 (トル)	反応温度 (℃)
TiC	TiCl ₄ : 2%, CH ₄ : 5%, H ₂ : 93%	100	1030
TiN	TiCl ₄ : 2%, N ₂ : 30%, H ₂ : 68%	100	980
TiCN	TiCl ₄ : 2%, CH ₃ : 5%, N ₂ : 20%, H ₂ : 73%	100	1000
TiCO	TiCl ₄ : 2%, CO : 6%, H ₂ : 92%	100	1000
TiCNO	TiCl ₄ : 2%, CO : 3%, N ₂ : 3%, H ₂ : 92%	100	1000
Al ₂ O ₃	AlCl ₃ : 5%, CO ₂ : 8%, H ₂ : 87%	100	1000

[0013]

[表3]

種別	基体 記号	硬質被覆層							
		下部層の組成および平均層厚 (括弧内: μm)				上部層の組成および平均層厚 (括弧内: μm)			
		第1層	第2層	第3層	第4層	第1層	第2層	第3層	第4層
1	A	TiN (1)	-	-	-	P+L(中) +P(7)	TiCO (0.5)	Al ₂ O ₃ (1.5)	-
		TiC (1)	-	-	-	P+L(上) (4)	TiN (0.5)	-	-
3	B	TiCN (2)	TiN (2)	-	-	L(下) +P(4)	-	-	-
4		TiCN (3)	-	-	-	P+L(上) (4)	Al ₂ O ₃ (1.5)	TiN (0.5)	-
5	C	TiCN (1)	-	-	-	P+L(上) (7)	TiCNO (0.5)	Al ₂ O ₃ (1.5)	TiN (1)
6		TiN (2)	-	-	-	P+L(上) (7)	TiCNO (0.5)	Al ₂ O ₃ (1.5)	-
7	D	TiN (1)	TiC (1)	TiN (1)	TiCO (1)	P+L(上) (1)	P+L(中) +P(2)	P+L(上) (2)	P+L(中) +P(2)
8		TiCN (2)	-	-	-	P+L(上) (5)	TiCNO (0.5)	Al ₂ O ₃ (1.5)	TiN (1)

表中: P: TiCNの粒状結晶組織、L: TiCNの線長成長結晶組織、
 上: 層上側、中: 層中間、下: 層下側をそれぞれ示す

[0014]

[表4]

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種別	基体 記号	硬質被覆層の組成および平均層厚 (括弧内: μm)				
		第1層	第2層	第3層	第4層	第5層
1	A	TiN(1)	TiCN(7)	TiCO(0.5)	Al_2O_3 (1.5)	-
		TiC(4)	TiCN(4)	TiN(0.5)	-	-
3	B	TiCN(2)	TiN(2)	TiCN(4)	-	-
		TiCN(7)	Al_2O_3 (1.5)	TiN(0.5)	-	-
5	C	TiCN(8)	TiCNO(0.5)	Al_2O_3 (1.5)	TiN(1)	-
		TiN(2)	TiCN(7)	TiCNO(0.5)	Al_2O_3 (1.5)	-
7	D	TiN(1)	TiCN(1)	TiN(1)	TiCN(7)	-
		TiCN(7)	TiCNO(0.5)	Al_2O_3 (1.5)	TiN(1)	-

従来被覆切削工具

[0015]

[表5]

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種 別		逃 げ 面 摩 耗 幅 (mm)	使用壽命に 至るまでの 使用壽命 (分)	種 別		逃 げ 面 摩 耗 幅 (mm)	使用壽命に 至るまでの 使用壽命 (分)
本 発 明 被 覆 切 削 工 具	1	0.18	16	従 来 被 覆 切 削 工 具	1	0.28	6
	2	0.26	17		2	0.37	7
	3	0.25	17		3	0.35	7
	4	0.17	15		4	0.28	5
	5	0.22	26		5	0.33	9
	6	0.24	25		6	0.35	8
	7	0.26	20		7	0.37	8
	8	0.20	19		8	0.30	7

【0016】 つぎに、この結果得られた各種の被覆切削工具について、

被削材：SCM440（硬さ：H_B 230）の丸棒、

切削速度：220m/min、

送り：0.2mm/rev、

切込み：1.5mm、

切削時間：30分、

の条件で鋼の乾式連続切削試験を行ない、切刃の逃げ面摩耗幅を測定し、さらに、

被削材：SNM439（硬さ：H_B 260）の角材、

切削速度：120m/min、

送り：0.3mm/rev、

切込み：3mm、

の条件で鋼の乾式断続切削試験を行ない、使用壽命に至るまでの切削時間を測定した。これらの測定結果を表5

に示した。

【0017】

【発明の効果】表1～5および図1、2に示される結果から、硬質被覆層のうちの下部層を構成するTiCNの1層または2層以上のが、粒状結晶組織から縦長成長結晶組織へ変る結晶構造、あるいは粒状結晶組織から縦長成長結晶組織へ、さらにこの縦長成長結晶組織から粒状結晶組織へ変る結晶組織、あるいは縦長成長結晶組織から粒状結晶組織へ変る結晶構造を有する本発明被覆切削工具1～8は、いずれも鋼の連続切削では、粒状結晶組織の硬質被覆層を形成してなる従来被覆切削工具1～8に比してすぐれた耐摩耗性を示し、また鋼の断続切削でも従来被覆切削工具1～8が切刃に発生したチップングが原因で比較的短時間で使用壽命に至るのに対して、一般とすぐれた耐チップング性を示し、長期に亘ってすぐ

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れた耐摩耗性を示すことが明らかである。

【0018】上述のように、この発明の表面被覆WC基超硬合金製切削工具は、すぐれた耐チップング性を有するので、例えば鋼や鋳鉄の連続切削は勿論のこと、耐チ

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ップング性が要求される、これらの断続切削においてもすぐれた耐摩耗性を示し、著しく長期に亘ってすぐれた切削性能を発揮するのである。

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Bibliography.

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Summary.

(57) [Abstract]

[Objects of the Invention] The chipping-proof nature of the cutting tool made from surface coating WC basis cemented carbide is raised.

[Elements of the Invention] The lower layer which becomes the front face of WC basis cemented carbide base from one-layer the monolayer or two or more sorts of double layers of the Ti compounds of TiC, TiN, TiCN, TiCO, and TiCNO, The aforementioned Ti compound and aluminum 2O3 While facing forming the hard enveloping layer which consisted of up layers which consist of one sort of inner monolayers, or two or more sorts of double layers and constituting at least one of the above-mentioned up layers from TiCN The crystal structure which changes from (a) granular crystalline structure to the longwise growth crystalline structure in at least one of these TiCN layers, (b) It considers as which the crystal structure of the crystal structures which change to the granular crystalline structure further from the granular crystalline structure to the longwise growth crystalline structure from the crystal structure which changes from this longwise growth crystalline structure to the granular crystalline structure, and (c) longwise growth crystalline structure.

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CLAIMS

[Claim(s)]

[Claim 1] In the cutting tool made from surface coating tungsten-carbide machine cemented carbide which comes to form in the front face of a tungsten-carbide machine cemented carbide base the hard enveloping layer which all has the granular crystalline structure by 0.5-20-micrometer average thickness The lower layer which consists the above-mentioned hard enveloping layer of one sort of monolayers of the carbide of Ti, a nitride, a charcoal nitride, a carbonation object, and the Ti compounds of a charcoal nitric oxide, or two or more sorts of double layers, While constituting from an up layer which consists of one sort of monolayers of the aforementioned Ti compound and the aluminum oxides, or two or more sorts of double layers and constituting at least one of the above-mentioned up layers from a charcoal titanium nitride The crystal structure of at least one layer of this charcoal titanium-nitride layer (a) The crystal structure which changes from the granular crystalline structure to the longwise growth crystalline structure, (b) The crystal structure which changes from the granular crystalline structure from this longwise growth crystalline structure to the granular crystalline structure further to the longwise growth crystalline structure, (c) Cutting tool made from surface coating

tungsten-carbide machine cemented carbide excellent in the chipping-proof nature characterized by considering as the crystal structure which changes from the longwise growth crystalline structure to the granular crystalline structure, and the crystal structure of either of above-mentioned (a) - (c).

[Claim 2] On the front face of a tungsten-carbide machine cemented carbide base on which the content of Co as a binder-phase formation component has many surface sections relatively as compared with the interior of a base In the cutting tool made from surface coating tungsten-carbide machine cemented carbide which comes to form the hard enveloping layer in which all have the granular crystalline structure by 0.5-20-micrometer average thickness The lower layer which consists the above-mentioned hard enveloping layer of one sort of monolayers of the carbide of Ti, a nitride, a charcoal nitride, a carbonation object, and the Ti compounds of a charcoal nitric oxide, or two or more sorts of double layers, While constituting from an up layer which consists of one sort of monolayers of the aforementioned Ti compound and the aluminum oxides, or two or more sorts of double layers and constituting at least one of the above-mentioned up layers from a charcoal titanium nitride The crystal structure of at least one layer of this charcoal titanium-nitride layer (a) The crystal structure which changes from the granular crystalline structure to the longwise growth crystalline structure, (b) The crystal structure which changes from the granular crystalline structure from this longwise growth crystalline structure to the granular crystalline structure further to the longwise growth crystalline structure, (c) Cutting tool made from surface coating tungsten-carbide machine cemented carbide excellent in the chipping-proof nature characterized by considering as the crystal structure which changes from the longwise growth crystalline structure to the granular crystalline structure, and the crystal structure of either of above-mentioned (a) - (c).

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the cutting tool made from surface coating tungsten-carbide (WC shows hereafter) machine cemented carbide which demonstrates the abrasion resistance which was excellent when it had the outstanding chipping-proof nature, therefore used for such intermittent cutting not to mention continuation cutting of steel, cast iron, etc.

[0002]

[Description of the Prior Art] Conventionally, generally it is indicated by JP,57-1585,A and JP,59-52703,A. The content of Co as a binder-phase formation component compares with WC basis cemented carbide base and a pan inside a base. relatively Many surface sections, Namely, a chemical vapor deposition and a physical vapor deposition are used for the front face of WC basis cemented carbide base which has Co enrichment surface section. The carbide of Ti with which all have the granular crystalline structure, a nitride, a charcoal nitride, a carbonation

object, And a charcoal nitric oxide and an aluminum oxide (it TiC(s), TiN(s), TiCN(s), TiCO(s) and TiCNO(s) hereafter, respectively) And aluminum 2O3 It is just going to be known well that the cutting tool made from surface coating WC basis cemented carbide which comes to form the hard enveloping layer which consists of one sort of monolayers of inside [being shown] or two or more sorts of double layers by 0.5-20-micrometer average thickness is used for continuation cutting of steel or cast iron.

[0003] Moreover, being manufactured by the way WC basis cemented carbide base which has the above-mentioned Co enrichment surface section blends charcoal nitride powder, such as nitride powder, such as TiN, and TaCN, CN, as for example, raw material powder, and carries out vacuum sintering of the green compact of this on condition that usual etc. is also known.

[0004]

[Problem(s) to be Solved by the Invention] On the other hand, although FA-izing and diversification of cutting technology in recent years are remarkable and the property of demonstrating the abrasion resistance which was excellent also in the cutting tool in connection with this with both for example, continuation cutting and intermittent cutting is required, the present condition is that are easy to generate a chipping in a cutting edge, and the above-mentioned cutting tool made from conventional surface coating WC basis cemented carbide results in a use life comparatively for a short time when this is used for intermittent cutting.

[0005]

[Means for Solving the Problem] Then, this invention person etc. pays his attention to the above-mentioned cutting tool made from conventional surface coating WC basis cemented carbide from the above viewpoints. As a result of inquiring to aim at improvement in the chipping-proof nature of this, generally it faces forming the TiCN layer as a hard enveloping layer by the chemical vapor deposition. Reactant-gas composition: It is TiCl₄ at capacity % : 1 - 5%, CH₄ : 5 - 7%, N₂ : 20 - 30%, H₂ : Remain, are formed on condition that reaction temperature:950-1050 degree-C, and ambient-pressure force:50-200torr **, and although it usually has the granular crystalline structure, the formed TiCN layer The conditions which made reaction temperature low temperature for the TiCN layer formation conditions of process relatively, and changed reactant gas composition the second half process of the TiCN layer formation which has this granular crystalline structure, middle process, or the first half, i.e., reactant gas composition, : by capacity % TiCl₄ : 1 - 4%, CH₃ CN:0.1-1%, N₂ : 0 - 25%, H₂ : If it remains and is made the conditions of reaction temperature:800-900 degree-C, and ambient-pressure force:30-200torr ** The TiCN layer of this result is (a), respectively. The crystal structure which changes from the granular crystalline structure to the longwise growth crystalline structure, (b) The crystal structure which changes from the granular crystalline structure from this longwise growth crystalline structure to the granular crystalline structure further to the longwise growth crystalline structure, (c) It comes to have the crystal structure which changes from the longwise growth crystalline structure to the granular crystalline structure, and the crystal structure of either of above-mentioned (a) - (c). And if at least one layer in the hard enveloping layer in which all that constitute the above-mentioned cutting tool made from surface coating WC basis cemented carbide had granular crystal composition is constituted from a TiCN layer with the crystal structure of either of above-mentioned (a) - (c) The cutting tool made from surface coating WC basis cemented carbide of this result The research result of having continued and demonstrating remarkably the abrasion resistance excellent also in such intermittent cutting as which it comes to provide the outstanding chipping-proof nature, for example, chipping-proof nature is required not to mention continuation cutting of steel or cast iron at a long period of time was obtained.

[0006] this invention is a cutting tool made from surface coating WC basis cemented carbide which is made by the thing based on the above-mentioned research result characterized by providing the following, and comes to form the hard enveloping layer which all has the granular crystalline structure in the front face of WC basis cemented carbide base or WC basis cemented carbide base which has Co enrichment surface section by 0.5-20-micrometer average thickness. The lower layer which consists the above-mentioned hard enveloping layer of one sort of monolayers of the Ti compounds of TiC, TiN, TiCN, TiCO, and TiCNO, or two or more sorts of

double layers. The aforementioned Ti compound and aluminum $2O_3$ While constituting from an up layer which consists of one sort of inner monolayers, or two or more sorts of double layers and constituting at least one of the above-mentioned up layers from TiCN The crystal structure of at least one layer of this TiCN layer (a) The crystal structure which changes from the granular crystalline structure to the longwise growth crystalline structure, (b) The crystal structure which changes from the granular crystalline structure from this longwise growth crystalline structure to the granular crystalline structure further to the longwise growth crystalline structure, (c) It is the feature to the cutting tool made from surface coating WC basis cemented carbide excellent in the chipping-proof nature which consists of the longwise growth crystalline structure as the crystal structure which changes to the granular crystalline structure, and the crystal structure of either of above-mentioned (a) - (c).

[0007] In addition, in the cutting tool made from surface coating WC basis cemented carbide of this invention, having set average thickness of a hard enveloping layer to 0.5-20 micrometers cannot secure the abrasion resistance which the thickness excelled [micrometers / less than 0.5] in the request brought about by the hard enveloping layer, but if the thickness exceeds 20 micrometers on the other hand, it will depend it on the reason for becoming easy to generate a chip in a cutting edge.

[0008]

[Example] Below, an example explains concretely the cutting tool made from surface coating WC basis cemented carbide of this invention. WC powder which has mean-particle-diameter: 3 micrometer as raw material powder — said — 1.5-micrometer C (Ti, W) powder (it is 30/70 at a TiC/WC= weight ratio) — said — 1.2-micrometer CN (Ti, W) powder (it is 24/20/56 at a TiC/TiN/WC= weight ratio) — said — 1.3-micrometer C (Ta, Nb) powder (TaC/NbC= weight ratios 90/10) — Prepare 1.2-micrometer Co powder and these raw material powder is blended with the combination composition shown in Table 1. and — said — After carrying out wet blending for 72 hours and drying with a ball mill, press forming is carried out to a green compact, and, subsequently to temperature: 1450 degree C, vacuum sintering of this green compact is carried out on condition that maintenance among a 1×10^{-2} to 2 torr vacuum for 1 hour. WC basis cemented carbide base D which has WC basis cemented carbide base A-C with the configuration of ISO-CNMG120408 and Co enrichment surface section (a maximum of Co content : 11 % of the weight, thickness : 20 micrometers) was manufactured, respectively. Moreover, about the above-mentioned WC basis cemented carbide base C, Co enrichment surface section (a maximum of Co content : 17 % of the weight, thickness : 40 micrometers) was formed by performing this the inside of 100 torr methane atmosphere, and performing carburization processing to temperature: 1400 degree C on condition that maintenance for 1 hour.

[0009] Subsequently, usual chemical-vacuum-deposition equipment is used for the front face of such WC basis cemented carbide base A-D. On the conditions which form the lower layer in which all that consist of a monolayer of the composition shown in Table 3 on the conditions shown in Table 2 and average thickness or more than two-layer have the granular crystalline structure, and are similarly succeedingly shown in Table 2 It faces forming the up layer which consists of a monolayer of the composition shown in Table 3, and average thickness, or more than two-layer. Besides, at least one layer in a member is used as a TiCN layer. at least one of the TiCN layers of a parenthesis by reactant gas composition: capacity % $TiCl_4$: 3%, CH_4 : 5%, N_2 : It remains. 25%, H_2 : by the granular crystalline-structure formation conditions of reaction temperature: 950 degree-C, and ambient-pressure force: 100 torr **, and reactant gas composition: capacity % $TiCl_4$: 1.5%, CH_3CN : 0.5%, N_2 : 25%, H_2 : It considers as the crystal structure which remains and is shown in Table 3, combining suitably the longwise growth crystalline-structure formation conditions of reaction temperature: 860 degree-C, and ambient-pressure force: 50 torr **. The cutting tools 1-8 made from this invention surface coating WC basis cemented carbide (henceforth this invention covering cutting tool) were manufactured, respectively.

[0010] Furthermore, when it had the composition shown in Table 4 on condition that usual [which is similarly shown in Table 2] on the front face of the above-mentioned WC basis cemented carbide base A-D, and average thickness and all formed the hard enveloping layer of

the granular crystalline structure, the cutting tools 1-8 made from surface coating WC basis cemented carbide (henceforth the conventional covering cutting tool) were manufactured conventionally, respectively.

[0011]

[Table 1]

種 別	配 合 組 成 (重量%)				
	Co	(Ti, W)C	(Ta, Nb)C	(Ti, W)CN	WC
A	6	-	-	-	残
B	8	5	5	-	残
C	5	5	5	-	残
D	7	-	4	6	残
超 硬 合 金 基 体					

[0012]

[Table 2]

硬質被覆 層組成	粒状結晶組織の硬質被覆層形成条件		
	反応ガス組成 (容量%)	反応雰囲気	
		圧力 (トル)	温度 (℃)
TiC	TiCl_4 : 2%, CH_4 : 5%, H_2 : 93%	100	1030
TiN	TiCl_4 : 2%, N_2 : 30%, H_2 : 68%	100	980
TiCN	TiCl_4 : 2%, CH_3 : 5%, N_2 : 20%, H_2 : 73%	100	1000
TiCO	TiCl_4 : 2%, CO : 6%, H_2 : 92%	100	1000
TiCNO	TiCl_4 : 2%, CO : 3%, N_2 : 3%, H_2 : 92%	100	1000
Al_2O_3	AlCl_3 : 5%, CO_2 : 8%, H_2 : 87%	100	1000

[0013]

[Table 3]

題 別	基 体 記 号	硬 質 被 覆 層							
		下部層の組成および平均層厚 (括弧内: μm)				上部層の組成および平均層厚 (括弧内: μm)			
		第1層	第2層	第3層	第4層	第1層	第2層	第3層	第4層
1	A	TiN (1)	-	-	-	P+L(中) +P(7)	TiCO (0.5)	Al ₂ O ₃ (1.5)	-
		TiC (1)	-	-	-	P+L(上) (4)	TiN (0.5)	-	-
2	B	TiCN (2)	TiN (2)	-	-	L(下) P(4)	-	-	-
		TiCN (3)	-	-	-	P+L(上) (4)	Al ₂ O ₃ (1.5)	TiN (0.5)	-
3	C	TiCN (1)	-	-	-	P+L(上) (7)	TiCNO (0.5)	Al ₂ O ₃ (1.5)	TiN (1)
		TiN (2)	-	-	-	P+L(上) (7)	TiCNO (0.5)	Al ₂ O ₃ (1.5)	-
4	D	TiN (1)	TiC (1)	TiN (1)	TiCO (1)	P+L(上) (1)	P+L(中) +P(2)	P+L(上) (2)	P+L(中) +P(2)
		TiCN (2)	-	-	-	P+L(上) (5)	TiCNO (0.5)	Al ₂ O ₃ (1.5)	TiN (1)

表中: P: TiCNの粒状結晶組織、L: TiCNの線長成長結晶組織、
上: 層上側、中: 層中間、下: 層下側をそれぞれ示す

[0014]

[Table 4]

種別	基体 記号	硬質被覆層の組成および平均層厚 (括弧内: μm)				
		第1層	第2層	第3層	第4層	第5層
1	A	TiN (1)	TiCN (7)	TiCO (0.5)	Al_2O_3 (1.5)	-
		TiC (4)	TiCN (4)	TiN (0.5)	-	-
3	B	TiCN (2)	TiN (2)	TiCN (4)	-	-
		TiCN (7)	Al_2O_3 (1.5)	TiN (0.5)	-	-
5	C	TiCN (8)	TiCNO (0.5)	Al_2O_3 (1.5)	TiN (1)	-
		TiN (2)	TiCN (7)	TiCNO (0.5)	Al_2O_3 (1.5)	-
7	D	TiN (1)	TiCN (1)	TiN (1)	TiCN (7)	-
		TiCN (7)	TiCNO (0.5)	Al_2O_3 (1.5)	TiN (1)	-

従来被覆切削工具

[0015]
[Table 5]

種 別		逃 げ 面 摩 耗 幅 (mm)	使用壽命に 至るまでの 使用壽命 (分)	種 別		逃 げ 面 摩 耗 幅 (mm)	使用壽命に 至るまでの 使用壽命 (分)
本 発 明 被 覆 切 削 工 具	1	0.18	16	従 来 被 覆 切 削 工 具	1	0.28	6
	2	0.26	17		2	0.37	7
	3	0.25	17		3	0.35	7
	4	0.17	15		4	0.28	5
	5	0.22	26		5	0.33	9
	6	0.24	25		6	0.35	8
	7	0.26	20		7	0.37	8
	8	0.20	19		8	0.30	7

[0016] various kinds of covering cutting tools obtained as a result next — the round bar of **ed material:SCN440 (hardness : HB [230]), and cutting-speed:220 m/min — sending — :0.2 mm/rev — cutting deeply — the conditions of :1.5mm and cutting-time:30-minute ** — the dry type continuation cutting examination of steel the width of flank wear land of a deed and a cutting edge — measuring — further — the square bar of **ed material:SNM439 (hardness : HB [260]), and cutting-speed:120 m/min — sending — :0.3 — it mm/rev and cut deeply, the dry type intermittent-cutting examination of steel was performed on condition that :3mm**, and the cutting time until it results in a use life was measured These measurement results were shown in Table 5.

[0017]

[Effect of the Invention] More than two-layer [of TiCN which constitutes the lower layer of the hard enveloping layers / one layer or two-layer] from the result shown in Tables 1-5 and drawing 1, and 2 To the longwise growth crystalline structure from the crystal structure which changes from the granular crystalline structure to the longwise growth crystalline structure, or the granular crystalline structure this invention covering cutting tools 1-8 which have the crystal structure which changes to the granular crystalline structure from the crystalline structure

which furthermore changes from this longwise growth crystalline structure to the granular crystalline structure, or the longwise growth crystalline structure The chipping to which the abrasion resistance which excelled [all] in continuation cutting of steel as compared with the covering cutting tools 1-8 conventionally which comes to form the hard enveloping layer of the granular crystalline structure was shown, and the covering cutting tools 1-8 also generated the intermittent cutting of steel in the cutting edge conventionally results in a use life comparatively for a short time owing to. It is clear that receive, the chipping-proof nature which was excellent in it being general is shown, and the abrasion resistance which continued and was excellent in the long period of time is shown.

[0018] As mentioned above, since the cutting tool made from surface coating WC basis cemented carbide of this invention has the outstanding chipping-proof nature, for example not to mention continuation cutting of steel or cast iron, it shows the abrasion resistance as which chipping-proof nature is required and which was excellent also in such intermittent cutting, and demonstrates the cutting-ability ability which continued and was remarkably excellent in the long period of time.

[Translation done.]